

REMARKS

Applicants request reconsideration of the Examiner's rejection of Claims 1-18 for the above-named application in view of the amendment submitted above and the following Remarks. Claims 1 and 4 have been canceled, and Claims 2, 3, and 5-18 remain in the case. Claims 2 and 3 have been amended to include the subject matter of Claim 1 from which they originally depended. Claim 5 has been amended to include the subject matter of Claims 1 and 4 from which Claim 5 originally depended. Claims 7 and 11 were amended to depend from Claim 5. The amendments to Claims 2, 3, 5, 7, and 11 were made as a matter of form to present the actual text of subject matter included in the original claims by virtue of their dependency from preceding claims. No subject matter was surrendered and the claims were not narrowed by this amendment.

1. Rejection of Claims 16-18 Under 35 U.S.C. 102(b)

Claims 16-18 have been rejected under 35 U.S.C. 102(b) as anticipated by Japanese Patent Publication JA-55-154925.

JA-55-154925 (according to the translation submitted by Applicants and cited by the Examiner) discloses a method of purifying tetrafluoromethane (CF_4) gas containing contaminants such as CF_3Cl and CF_2Cl_2 wherein the contaminant-containing gas is treated by contact with a laser to convert the contaminants to C_2F_6 and chlorine. The C_2F_6 and chlorine are then removed by a distillation device, flash separator, or an adsorption/distillation device (p. 4, lines 12-13).

The embodiment of the invention as claimed is a high purity perfluoromethane (CF_4) product obtained by contacting a gas mixture comprising CF_4 and at least perfluoroethane (C_2F_6) with a zeolite adsorbent of the mordenite structure having a Si/Al atomic ratio of less than about 50. At least a portion of the C_2F_6 is adsorbed by the adsorbent and a gas enriched in CF_4 is withdrawn to provide a high purity CF_4 product. The zeolite adsorbent may be decationized such that at least about 50% of the cations are replaced with protons. The high purity CF_4 may comprise at least 99.99 vol% CF_4 .

In order to anticipate a claimed invention, a single prior art document must identically disclose all elements of the claimed invention. In a product by process claim, the process of making is a limitation to the product and thus characterizes the product. Applicants respectfully submit that the cited JA-55-154925 does not identically disclose the claimed invention because it discloses only that C_2F_6 and chlorine can be removed from a mixture of CF_4 , C_2F_6 , and chlorine by a distillation device, flash separator, or an adsorption/distillation device. In contrast, Applicants' product is characterized by purification by adsorption using a zeolite adsorbent of the mordenite structure having a Si/Al ratio of less than about 50.

The cited JA-55-154925 discloses a distillation device, flash separator, and an adsorption/distillation device, but does not disclose an adsorption process as claimed. Further, there is no disclosure in JA-55-154925 regarding the use of a zeolite adsorbent of the mordenite structure having a Si/Al ratio of less than about 50 as claimed. For these reasons, Applicants submit that the claimed invention is not identically disclosed by JA-55-154925 and request that the Examiner withdraw the rejection of Claims 16-18 over JA-55-154925.

2. Rejection of Claims 2 and 5-15 Under 35 U.S.C. 103(a)

Claims 2 and 5-15 have been rejected as being unpatentable under 35 U.S.C. 103(a) over U.S. Patent 5,417,742 to S. S. Tamhankar ("Tamhankar") in combination with U.S. Patent 6,187,077 to Y. Li ("Li").

Tamhankar discloses the separation of one or more gaseous fluorocarbons from a gas stream containing at least one permanent gas by passing the gas stream through one or more of certain energetically homogenous, silicon-rich, microporous adsorbents and/or one or more of certain energetically homogenous mesoporous adsorbents. The perfluorocarbons are more strongly adsorbed than are the other components in the gas stream. The perfluorocarbons are recovered from the adsorbent by conventional regeneration means.

Li discloses a process for separating at least one of CF_4 and C_2F_6 from a gas mixture comprising (i) at least one of CF_4 and C_2F_6 , (ii) at least one of NF_3 , CHF_3 , and N_2 , and (iii)

SF₆ with a membrane. The separation yields a retentate stream rich in SF₆ and at least one of CF₄ and C₂F₆ and a permeate stream rich in at least one of NF₃, CHF₃, and N₂. The retentate stream is contacted with an adsorbent at conditions to adsorb SF₆ and produce a product stream rich in at least one of CF₄ and C₂F₆.

An embodiment of the present invention as defined in Claim 2 is a method for removing perfluoroethane (C₂F₆) from a gas mixture comprising perfluoroethane and one or more other fluorocarbon compounds, which method comprises contacting the gas mixture with an adsorbent comprising zeolite of the mordenite structure wherein at least a portion of the C₂F₆ is selectively adsorbed by the adsorbent, and withdrawing a C₂F₆-depleted gas product from contact with the adsorbent, wherein the zeolite adsorbent has a silicon to aluminum (Si/Al) atomic ratio of less than about 50.

An embodiment of the present invention as defined in Claim 5 and dependent claims is a method for removing C₂F₆ from a gas mixture comprising C₂F₆ and one or more other fluorocarbon compounds including CF₄ by contacting the gas mixture with an adsorbent comprising zeolite of the mordenite structure wherein at least a portion of the C₂F₆ is selectively adsorbed by the adsorbent, and withdrawing a C₂F₆-depleted gas product from contact with the adsorbent, wherein the C₂F₆-depleted gas product comprises CF₄.

The embodiment of present Claim 2 differs from Tamhankar because the claimed process uses a zeolite adsorbent of the mordenite structure wherein the zeolite adsorbent has a (Si/Al) atomic ratio of less than about 50. In contrast, the mordenite adsorbent of Tamhankar has a (Si/Al) atomic ratio of at least 50.

The embodiment of present Claim 2 differs from Li because the claimed process uses a zeolite adsorbent of the mordenite structure to adsorb C₂F₆ whereas, in contrast, Li's adsorption process operates to separate SF₆ from a mixture of SF₆ with at least one of the perfluorocarbons CF₄ and C₂F₆ (see column 2, lines 43-46 and column 4, lines 38-43). In Li's process, the SF₆ is adsorbed and fluorocarbons are not adsorbed. Further, Li's adsorbents (column 4, lines 38-50) do not include zeolite adsorbents of the mordenite structure as claimed.

The embodiments of the present invention as defined in Claim 5 and dependent claims differ from Tamhankar because in the presently claimed process, the C_2F_6 -depleted gas product comprises CF_4 and the process thus operates to separate C_2F_6 from CF_4 . In contrast, Tamhankar's process operates to separate perfluorocarbons from an inert gas so that the perfluorocarbons can be recycled to an upstream reactor (see column 4, lines 38-43). No separation is made in Tamhankar's process between any of the fluorocarbons; instead, its separation is made between fluorocarbons and inert gas.

The embodiments in Claim 5 and dependent claims differ from Li because in the presently claimed process, the C_2F_6 -depleted gas product comprises CF_4 and the process thus operates to separate C_2F_6 from CF_4 . In contrast, Li's adsorption process operates to separate SF_6 from a mixture of SF_6 with at least one of the perfluorocarbons CF_4 and C_2F_6 (see column 2, lines 43-46 and column 4, lines 38-43). No separation is made in Li's process between any of the fluorocarbons; instead, the separation is made between the fluorocarbons and SF_6 .

In the adsorptive process of Tamhankar, the perfluorocarbons are more strongly adsorbed than the other components in the gas stream (i.e., inert gases). In contrast, in the adsorptive process of Li, the non-perfluorocarbon (i.e., SF_6) is more strongly adsorbed than the perfluorocarbons. Thus Tamhankar and Li provide diametrically-opposed advice regarding which component is adsorbed from a perfluorocarbon-containing mixture to be separated. Because of the diametrically-opposed teachings of Tamhankar and Li, the skilled person would have no motivation to combine these references to arrive at the process of present Claim 2.

In addition, Tamhankar is silent regarding the possibility of varying the Si/Al ratio, and states only that this ratio is at least 50. No mention is made of the possibility that this ratio could be less than 50, as presently claimed.

Li mentions Si/Al ratios of 1:1 to 100:1, but these ratios pertain only to recited adsorbents (not stated to include mordenite) that preferentially adsorb SF_6 rather than fluorocarbons, and these Si/Al ratios therefore are not relevant to the presently claimed process using an adsorbent that adsorbs C_2F_6 . Li's requirement that the adsorbent

selectively adsorb SF_6 over C_2F_6 teaches away from the embodiment of present Claim 2 and causes Li to be defective as a reference regarding the patentability of present Claim 2.

In contrast to present Claim 5, both Tamhankar and Li disclose the adsorptive separation of perfluorocarbons from non-perfluorocarbons, i.e., from inert gas and SF_6 , respectively. Both Tamhankar and Li thus teach away from the presently claimed invention of Claim 5, which recites the separation of a perfluorocarbon from another perfluorocarbon, i.e., the separation C_2F_6 from CF_4 . A person skilled in the art of gas separation by adsorption, particularly the separation of perfluorocarbons, would find nothing in either Tamhankar or Li to suggest the adsorptive separation between different fluorocarbons. Tamhankar or Li thus are defective references for use by the Examiner to reject Applicants' Claim 5 and its dependent claims.

In the adsorptive process of Tamhankar, the perfluorocarbons are more strongly adsorbed than the other components in the gas stream (i.e., inert gases). In contrast, in the adsorptive process of Li, the non-perfluorocarbon (i.e., SF_6) is more strongly adsorbed than the perfluorocarbons. Thus, Tamhankar and Li provide diametrically-opposed teachings regarding which component is adsorbed from a perfluorocarbon-containing mixture to be separated. Because of the diametrically-opposed teachings of Tamhankar and Li, the skilled person would have no motivation to combine these references to devise a method for separating a perfluorocarbon from another perfluorocarbon. Even if the references were combined, the combined teaching would be completely indefinite regarding how to separate a perfluorocarbon from another perfluorocarbon, as recited in present Claim 5 and its dependent claims.

Dependent Claims 6-15 as amended include all limitations of Claim 5, and are therefore patentable over Tamhankar and Li, as argued above for Claim 5.

For these reasons, Applicants respectfully submit that the Examiner has improperly rejected Claims 2 and 5-15 under 35 U.S.C. 103(a) over Tamhankar and Li, and they request that the rejection be withdrawn.

3. Rejection of Claim 3 Under 35 U.S.C. 103(a)

Claim 3 has been rejected as unpatentable over Tamhankar and Li as applied above and further in view of U.S. Patent 5,210,308 to K. Segawa et al ("Segawa").

Segawa discloses a process for the production of a modified H-mordenite which comprises contacting an alkali metal or alkaline earth metal-type mordenite with SiCl_4 under heating and then converting the treated mordenite into an H-type by ion exchange, a catalyst comprising the modified H-mordenite, and a process for the production of methylamines using this catalyst.

The distinctions over Tamhankar and Li are summarized above and are incorporated herein.

An embodiment of the present invention as recited in Claim 3 is a method for removing perfluoroethane (C_2F_6) from a gas mixture comprising perfluoroethane and one or more other fluorocarbon compounds, which method comprises contacting the gas mixture with an adsorbent comprising zeolite of the mordenite structure wherein at least a portion of the C_2F_6 is selectively adsorbed by the adsorbent, and withdrawing a C_2F_6 -depleted gas product from contact with the adsorbent. The zeolite adsorbent is decationized such that at least about 50% of the cations are replaced with protons.

Segawa teaches away from the presently claimed embodiment by requiring that the modified H-mordenite be used in a process for the production of methylamines. There is no suggestion that this H-mordenite could be used for gas separation, and there is nothing disclosed by Segawa that would motivate the skilled person to employ H-mordenite as a gas separation adsorbent.

Each of the three cited references teach away from the presently claimed embodiments, and all are defective references for use by the Examiner to reject Applicants' claims. There is nothing disclosed in any of the references to motivate the skilled person to combine the references. The skilled person who understood the state of the art as defined

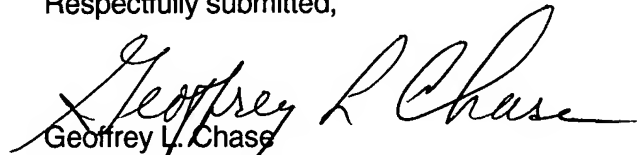
by Segawa, Tamhankar, and Li would find no teaching therein to suggest the presently claimed embodiment.

For these reasons, Applicants respectfully submit that the Examiner has improperly rejected Claim 3 under 35 U.S.C. 103(a) over the combination of Tamhankar, Li, and Segawa, and they request that the rejection be withdrawn.

Summary

In view of the amendments and arguments submitted above, the Examiner is respectfully requested to reconsider and withdraw the rejection of Claims 16-18 under 35 U.S.C. 102(b) as anticipated by Japanese Patent Publication JA-55-154925, the rejection of Claims 2 and 5-15 under 35 U.S.C. 103(a) over the combination of Tamhankar and Li, and the rejection of Claim 3 under 35 U.S.C. 103(a) over the combination of Tamhankar, Li, and Segawa. A timely Notice of Allowance for Claims 2, 3, and 5-18 is respectfully requested at the examiner's earliest convenience.

Respectfully submitted,


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